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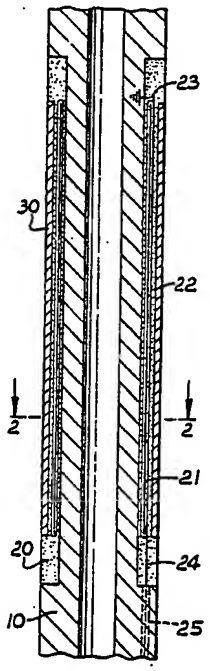
(54) Title: COLLAR ASSEMBLY FOR TELEMETRY

(57) Abstract

A telemetry assembly for inclusion in a drill string or the like comprises a collar (10) carrying a coil (22) wound on a ferromagnetic toroid (21). These are positioned in a recess in the collar which is filled with a dielectric material (20). The coil (22) is surrounded by a ferromagnetic sheath (30)



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Collar assembly for telemetry

This invention relates to an assembly which facilitates telemetry transmission and/or reception, such as measuring borehole data and transmitting the data to a remote (e.g. surface) location for analysis. The invention when applied to a borehole, may be used at any time during the drilling of the borehole but is primarily used in providing real time transmission of large quantities of data gathered near the drill bit simultaneously while drilling. This concept is referred to in the oil industry as measurement while drilling (MWD).

The measurement while drilling concept offers substantial incentives. This concept will allow safer, more efficient, and more economical drilling of both exploration and production wells.

One method presently being used for the transmission of data from the borehole comprises the transmission of electromagnetic waves through the drill pipe and the earth. In this method the electromagnetic pulses carrying down hole data are input into a toroid positioned in the drill string above the drill bit. The primary winding, carrying the data for transmission is wrapped around the toroid and a secondary winding is formed by the drill pipe. A receiver at the surface picks up the coded magnetic pulses, decodes the data, displays the data and records the data for future use.

A problem which is encountered in conventional drill string toroid design is that an outer sheath which must protect the toroid windings must also provide structural integrity for the toroid. With the toroid located in the drill collar, mechanical stresses such as tension, compression, torsion and column bend will be imposed on it. The structural problem is enhanced when it is realised that the electrically conductive drill collar is attached to both ends of the toroid

outer sheath. This type of structure can easily provide a path for short circuiting the data transmission to earth. It is essential to provide insulation between the toroid outer sheath and the drill collar while withstanding severe environmental loading.

The invention is also applicable to transmitting data from other situations. One of particular interest is transmitting data from the interior of a pipeline. At present, pipeline inspection vehicles, or "pigs", capture data on magnetic tape or other recording medium, and the data is not available until the pig has emerged. There are obvious benefits in transmitting the data for real-time analysis.

The invention accordingly provides a telemetry assembly comprising a substantially cylindrical body having at least an annular zone of dielectric material, a toroid and a primary winding therearound located within said dielectric material in said annular zone but of lesser axial length than said annular zone, the primary winding being arranged for connection to an adjacent transmitting or receiving circuit, and a ferrous sleeve overlying the toroid and forming part of the outer surface of said body.

In one form of the invention, the body is of metal and the toroid is positioned in an annular recess in the body, said sleeve cooperating with said recess to define an annular space within which said toroid is located and to define axial spaces between each end of the sleeve and the shoulders of the recess, and a dielectric material filling said annular and axial spaces.

The body may be a drill collar in the form of an integral member, the toroid and sleeve are fabricated within the recess, and the dielectric material is a mouldable material moulded within said space so as to bond the toroid and sleeve in position. Alternatively,

the collar comprises two parts removably secured together, the dielectric material is pre-formed in two or more cooperating parts, the toroid and primary winding being embedded in one of said parts, and said parts interfitting to trap the sleeve.

The dielectric material is suitably a mouldable plastics material of good mechanical strength and abrasion resistance. Examples of suitable materials are ptfe and glass-reinforced plastics (grp) using polyester or epoxy resins.

In another form of the invention the collar is entirely of dielectric material, being a material which has suitable mechanical strength, resistance to abrasion and dielectric properties, and which can be moulded or cast. One suitable material is Kevlar (Trade Mark).

Embodiments of the invention will now be described by way of example, with reference to the accompanying drawings, in which:-

Fig. 1 is a longitudinal cross-section of an assembly embodying the invention;

Fig. 2 is a transverse cross-section on the line 2-2 of Fig. 1;

Fig. 3 is a perspective view of a second embodiment;

Fig. 4 is an exploded view of the assembly of Fig. 3;

Fig. 5 is a longitudinal cross-section of the toroid and associated dielectric in the embodiment of Fig. 3;

Fig. 6 is a longitudinal cross-section of the embodiment of Fig. 3; and

Fig. 7 is a longitudinal cross-section of another embodiment.

Referring to Figs. 1 and 2, the assembly comprises a drill collar 10 which has an annular undercut in which is received a dielectric material 20, a toroid assembly 21,22 and a ferromagnetic outer sleeve 30.

The toroid assembly comprises a ferromagnetic cylinder 21 around which is would a primary winding 22 with turns arranged axially, which is connected to system earth on the collar 10 at 23 and via a lead 24 and fluid-to-air connector 25 to a data transmitter (not shown).

The sleeve 30, which is preferably of steel, acts both as a transformer core and as a mechanical protection for the toroid.

The toroid assembly 21,22 and sleeve 30 are suitably made in sheet form, wrapped in position around the collar 10, and have their ends butt-joined by welding or soldering to form closed shapes. In this embodiment, the dielectric material 20 is suitably grp applied by hand lay-up techniques.

The toroid assembly 21,22 is insulated from both the collar 10 and the sleeve 30 by layers of grp. It will be noted that the toroid assembly 21,22 and the sleeve 30 are of the same axial extent, and that these are spaced at either end from the shoulders of the collar by a substantial volume of dielectric; these features are of importance in obtaining the full benefit of the invention.

Turning to the embodiment of Figs. 3 to 6, this is of similar geometry to the above embodiment, like reference numerals being used to denote like parts. In this embodiment, however, the collar comprises a main body 10' and an end member screw-threadedly engageable therewith to define the annular recess, and the dielectric comprises a main body 20' engageable butt-wise with an end member 40. The toroid assembly 21,22 is moulded into the main body 20'. The dielectric parts in this embodiment do not require to be moulded <u>in situ</u> and can thus, for example, be injection moulded from ptfe.

This embodiment can readily be assembled and and disassembled as indicated in the drawings. This simplifies repair, but at the expense of greater complexity and production cost in comparison with the first embodiment.

The embodiment of Fig. 7 is similar to those described above, but with the following modifications.

One modification is that the main drill collar 10 and annular dielectric material 20 of Fig. 1 are replaced by a unitary dielectric sleeve 70 in which the toroid assembly and outer sleeve are cast. The sleeve 70 is of a material which has suitable mechanical strength, resistance to abrasion and dielectric properties, and which can be moulded or cast, preferably Kevlar.

Secondly, the toroid assembly is modified in that it comprises a ferromagnetic cylinder 21 around which a primary winding 22' extends, its turns being arranged circumferentially.

The above embodiments describe the invention as being particularly applicable to the transmission of data from boreholes, the collar assembly forming part of the drill string. The assembly can in fact be used for telemetry in other situations. One of particular interest is transmitting data from the interior of a pipeline, in which application the assembly suitably forms part of an inspection apparatus moved through the pipeline in any suitable known manner. Telemetry may be achieved by electromagnetic propagation through the pipeline itself or, in the case of an underwater pipeline, through the overlying water to a surface vessel.

The assembly of the invention can also be used for receiving data.

CLAIMS

1. A telemetry assembly comprising a substantially cylindrical body having at least an annular zone of dielectric material, a toroid and a primary winding therearound located within said dielectric material in said annular zone but of lesser axial length than said annular zone, the primary winding being arranged for connection to an adjacent transmitting or receiving circuit, and a ferrous sleeve overlying the toroid and forming part of the outersurface of said body.

2. The assembly of claim 1, in which the body is of metal and the toroid is positioned in an annular recess in the body, said sleeve cooperating with said recess to define an annular space within which said toroid is located and to define axial spaces between each end of the sleeve and the shoulders of the recess, and a dielectric material filling said annular and axial spaces.

3. The assembly of claim 2, in which the body is an integral member, the toroid and sleeve are fabricated within the recess, and the dielectric material is a mouldable material moulded within said space so as to bond the toroid and sleeve in position.

4. The assembly of claim 2, in which the body comprises two parts removably secured together, the dielectric material is pre-formed in two or more cooperating parts, the toroid and primary winding being embedded in one of said parts, and said parts interfit to trap the sleeve.

5. The assembly of any of claims 2 to 4, in which the dielectric material is ptfe, glass-reinforced polyester or epoxy resin, or Kevlar.

6. The assembly of claim 1, in which the body is entirely of dielectric material, being a material which has suitable mechanical strength, resistance to abrasion

and dielectric properties, and which can be moulded or cast.

7. The assembly of claim 6, in which the material is Kevlar.

8. A telemetry assembly in accordance with any of claims 1 to 7, in which the body is in the form of a collar for inclusion in a drill string.

9. A telemetry assembly in accordance with any of claims 1 to 7, in which the assembly is adapted to be passed through a pipeline.

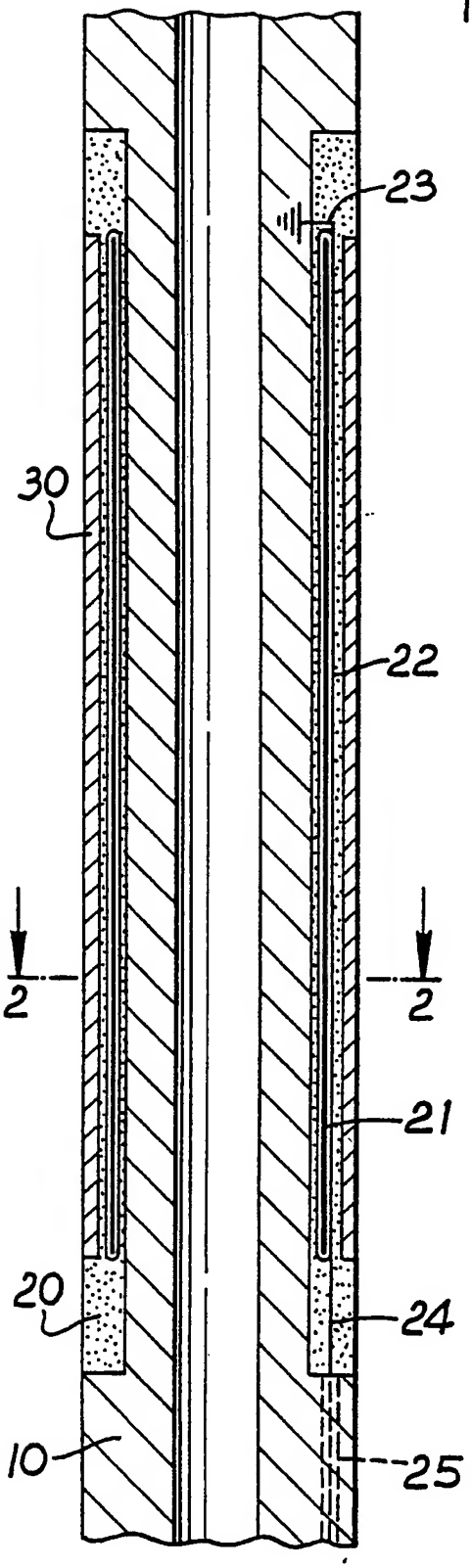

Fig. 1

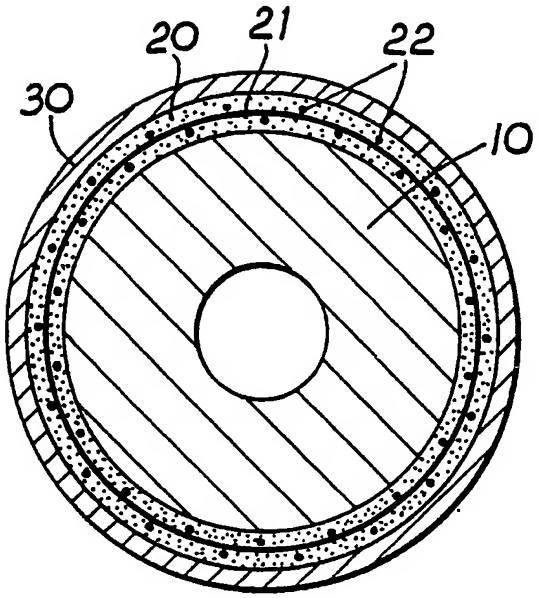

Fig. 2

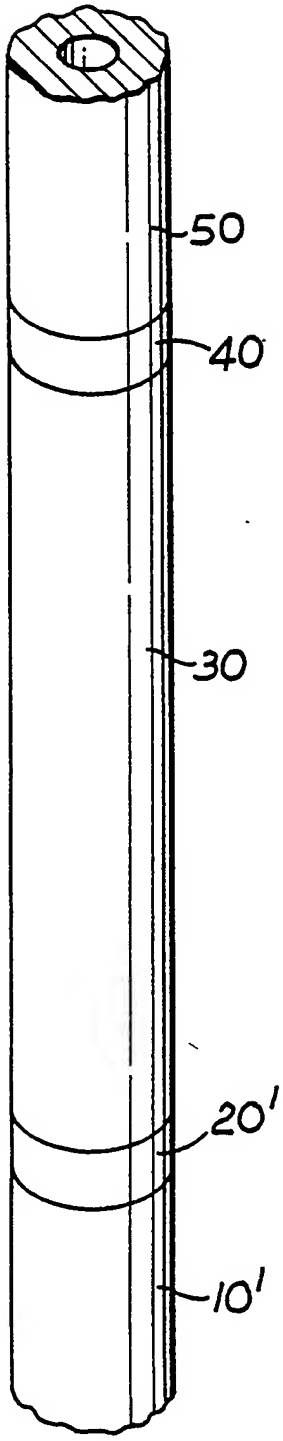

Fig. 3

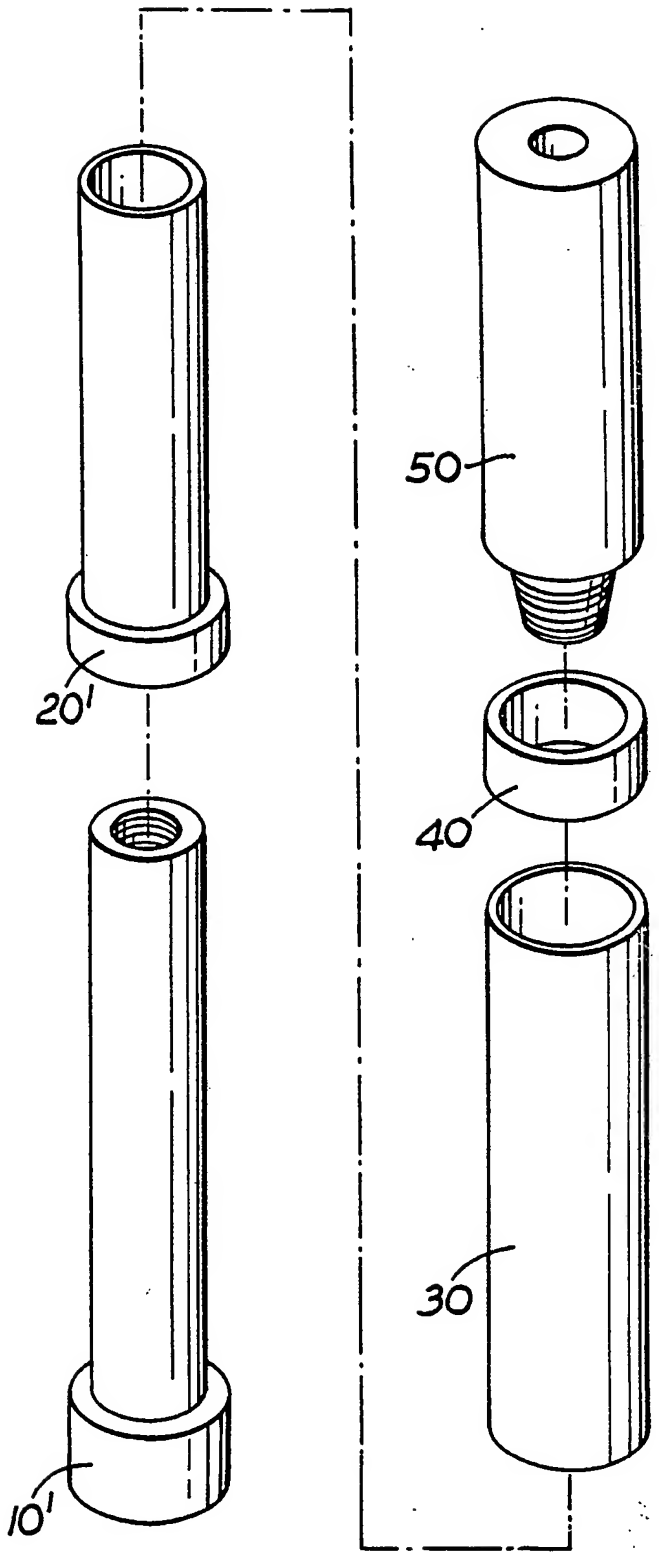

Fig. 4

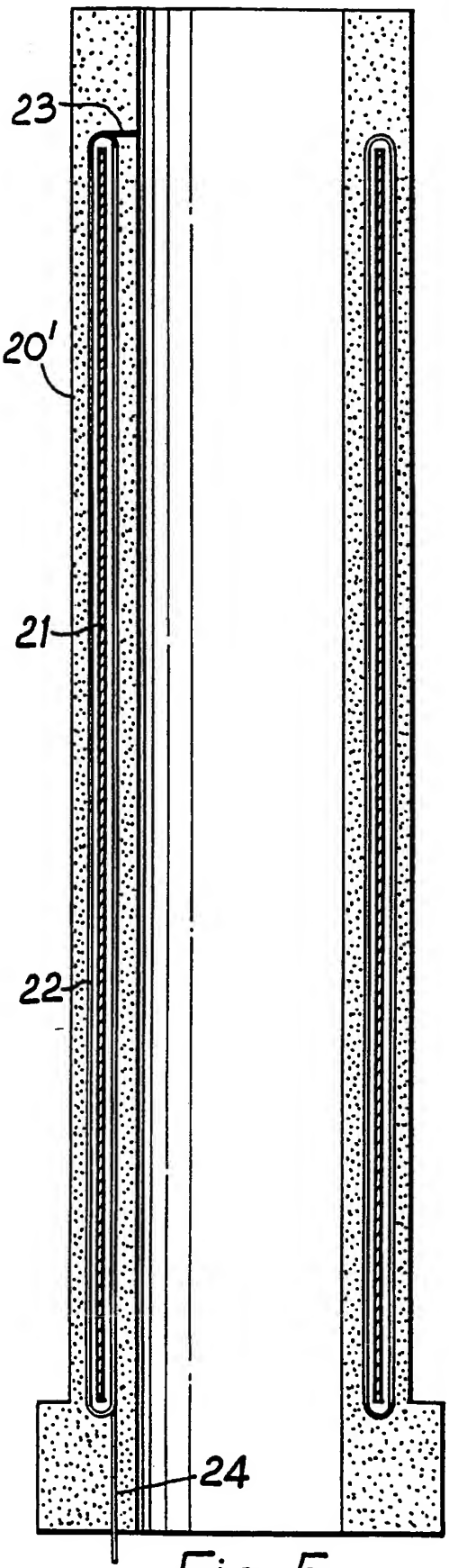

Fig. 5

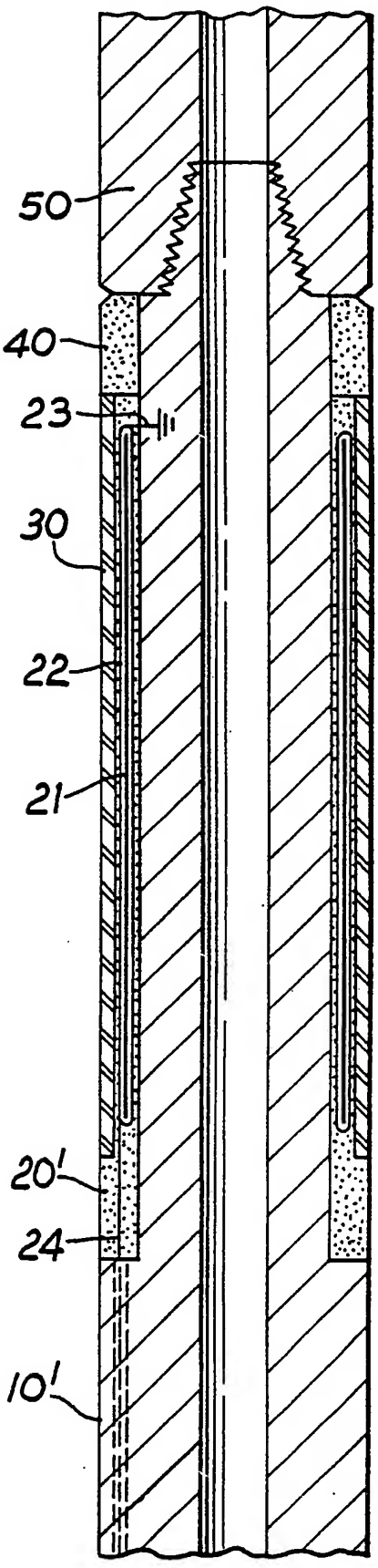

Fig. 6

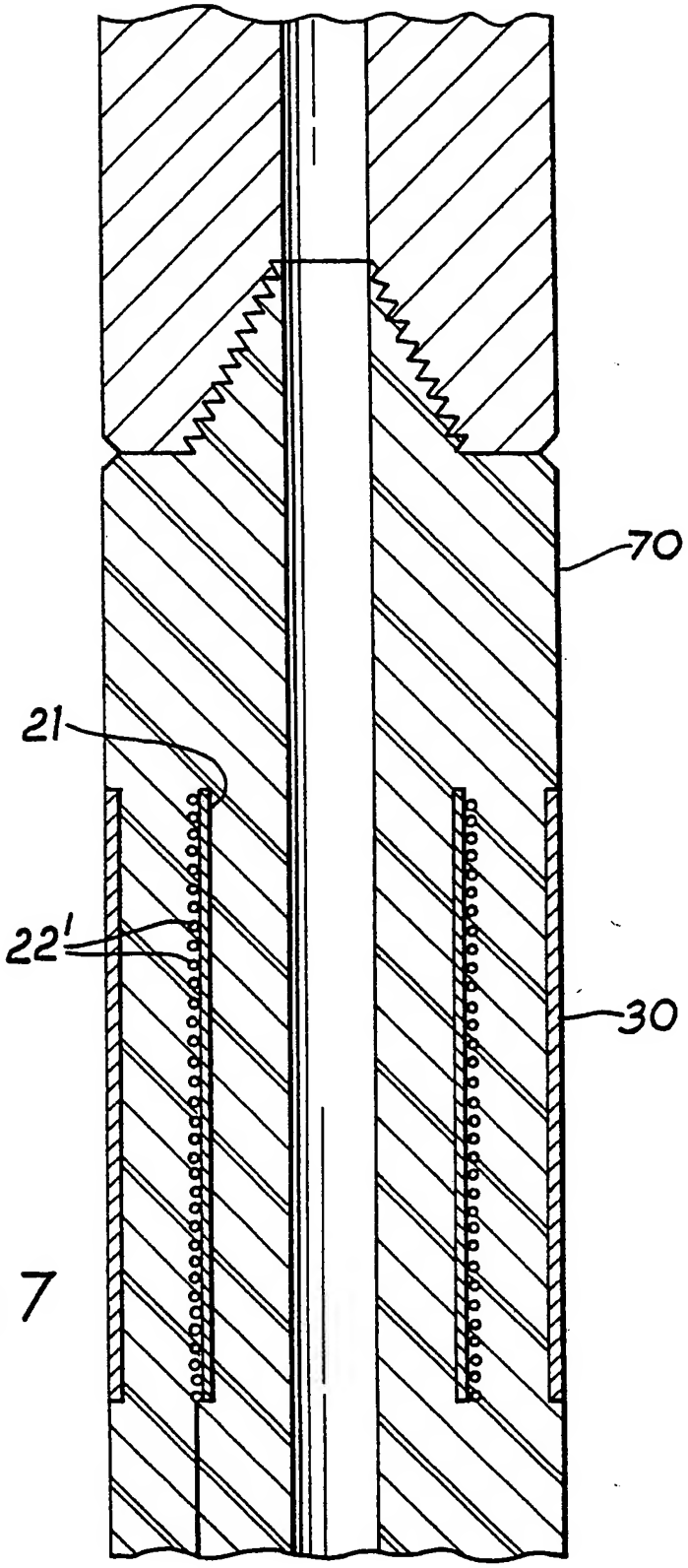

Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 85/00265

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: E 21 B 47/12; E 21 B 17/16; H 04 B 5/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	E 21 B G 01 V H 01 Q; H 01 F; H 04 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	WO, A, 84/01439 (MAC LEOD) 12 April 1984, see page 14, lines 14-32; page 18, lines 21-26; page 19, line 31 - page 20, line 8	1,8
A	--	2,3
Y	US, A, 3079549 (MARTIN) 26 February 1963, see column 3, lines 45-55; column 4, lines 8-13,20-23	1,8
A	--	2,4
A	US, A, 3186222 (MARTIN) 1 June 1965, see column 3, lines 41-52 - column 4, line 69 - column 5, line 1	1,2,4,8
A	--	
A	US, A, 2354887 (SILVERMAN) 1 August 1944, figure 2; page 2, left-hand column, lines 34-52 and right-hand column, lines 31-38	1-3,5,8
A	--	
A	US, A, 4181014 (ZUVELA) 1 January 1980, see column 6, lines 23-31; claim 5; figure 2	1,2,8
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
20th September 1985	23 OCT. 1985
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

Form PCT/ISA/210 (second sheet) (January 1985)

International Application No. PCT/GB 85/00265

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A, 4348672 (GIVLER) 7 September 1982, see column 2, line 48 - column 3, line 2; column 8, lines 7-13 --	1,5-8
A	US, A, 2941784 (MARTIN) 21 June 1960, column 3, lines 23-44; column 5, lines 63-75 --	1,3,4,8
A	EP, A, 0051018 (THORAVAL) 5 May 1982, see page 36, line 25 - page 37, line 11; page 37, lines 31-35 --	1,5
E	GB, A, 2146126 (MEADOR) 11 April 1985, page 5, lines 93-120; page 6, line 112 - page 7, line 37; claims 8,19	1-3,5,8

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 85/00265 (SA 9906)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 18/10/85

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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO-A- 8401439	12/04/84	AU-A-	2201783	24/04/84
		EP-A-	0120091	03/10/84
US-A- 3079549		None		
US-A- 3186222		None		
US-A- 2354887		None		
US-A- 4181014	01/01/80	None		
US-A- 4348672	07/09/82	None		
US-A- 2941784		None		
EP-A- 0051018	05/05/82	FR-A,B	2492540	23/04/82
		JP-A-	57096282	15/06/82
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		US-A-	4511843	16/04/85
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